大同大學 101 學年度研究所碩士班入學考試試題

考試科目:電子學　　所別:電機工程研究所　　

註:本次考試 不可以參考自己的書籍及筆記； 不可以使用字典； 可以使用計算器。

1. (16%) Find V_1~V_4 and I_1~I_4 in the circuit shown in Fig. 1. Assume $|V_{BE}|$=0.7V, $|V_{CE(sat)}|$=0.2V and $\beta=\infty$.

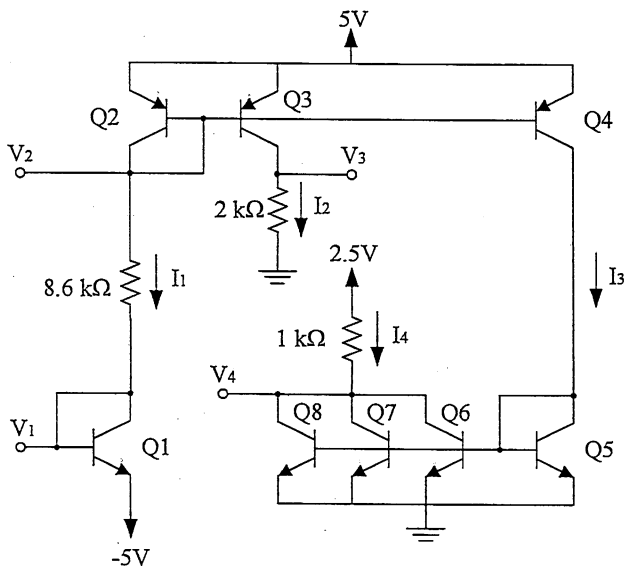

Fig.1

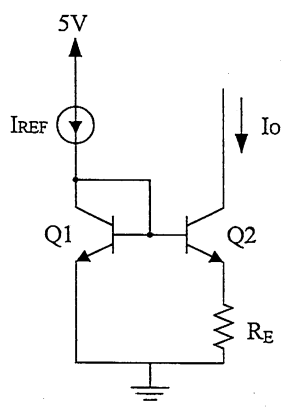

Fig.2

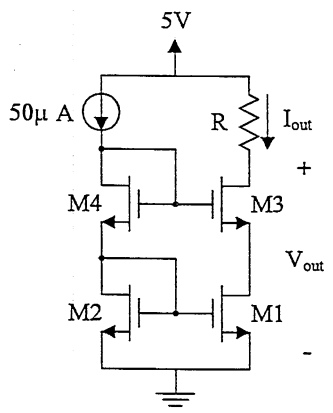

Fig.3

2. (16%) Consider the Widlar current source shown in Fig. 2 for generating a constant current I_O=100μA with I_{REF}=1mA.

(a) Determine the value of R_E.

(b) Estimate the output resistance for β=100 and V_A=100V.

3. (16%) Consider the cascode current mirror as shown in Fig. 3, where all the transistors are identical with $\mu_n C_{ox}$=160μA/V^2, V_{tn}=0.5 V and W/L =10.

(a) What is the maximum resistance R for the cascode current mirror shown in the figure without any transistors entering the triode region? (Neglect the body effect and the channel length modulation effect of the transistors.)

(b) Estimate the output resistance seen into transistors M3, where λ=0.1 V^{-1}.

4. (16%) Consider the circuit shown in Fig. 4.

(a) Find the feedback factor β.

(b) Assuming the opamp is ideal, find the closed-loop gain v_O/v_I. If v_I=0.5V, determine v_n.

(c) Repeat part (b), if the opamp gain is A=500.

(d) If the op amp is nonideal, and has a low-frequency gain of 500 and a single-pole rolloff at 5 kHz, determine bandwidth of the feedback circuit.

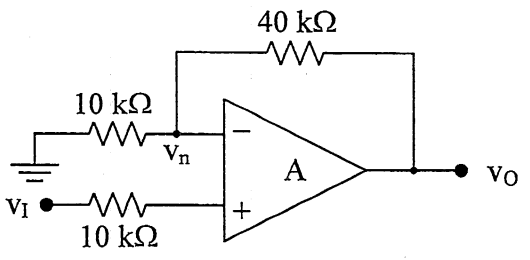

Fig. 4

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5. (20%) Consider the two-stage amplifier shown in Fig. 5, where $\mu_n C_{ox}$=160μA/V^2, $\mu_p C_{ox}$ =64μA/V^2, V_{tn}=|V_{tp}|=0.5V, λ_n=λ_p =0.1 V^{-1}. All the transistors have a channel length of 1μm, and the channel widths are indicated in the figure.

(a) Determine the transistor currents I_{D1}- I_{D10}.

(b) Find the low-frequency gain for the first and second stages (v_{o1} /v_d and v_{o2}/v_{o1}), respectively. v_d is the voltage difference between v_{IN+} and v_{IN-}.

(c) Neglecting the internal capacitances, estimate the pole due to the compensation capacitor Cc.

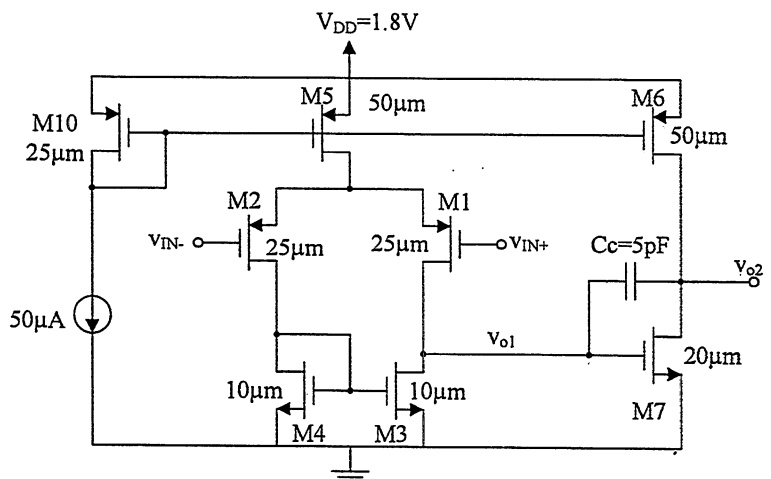

Fig.5

6. (16%) The circuits of Fig.6 show different implementations of an inverter. Neglect the body effect. (V_{tn}=|V_{tp}|=0.5V)

(a) Determine V_{OH} (output at V_{in}=0V) of the 3 inverters inverters.

(b) Calculate the static power consumption at V_{in}=0V.

(c) V_{OL} (output at V_{in}=V_{DD}) of which circuit(s) is 0 V?

(d) Determine the static power consumption at V_{in}=1.8V. (β_n=4×β_p =320μA/V^2)

(e) Which circuit(s) is(are) a ratio circuit(s)? (i.e. the proper functionality of the circuit depends on the size of the devices.)

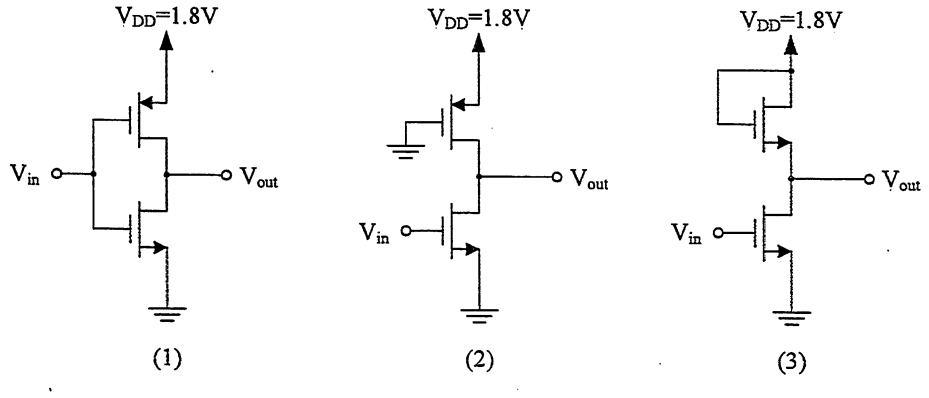

Fig.6